NEIGHBOURHOOD EFFECTS IN EDUCATIONAL OUTCOMES WITH NON-RANDOM ASSIGNMENT: A MEMBERSHIPS APPROACH

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Abstract

In 1966, the controversial Coleman report indicated that the educational achievement of Black students in U.S. schools was positively related to the fraction of White students in their school. Since the publication of this report, several researchers have attempted to answer questions relating to social interactions, neighbourhood effects and the strength of peer-group in influencing outcomes. This paper uses a unique dataset from a large university in South Africa to analyse the role that neighbourhood and race effects play in determining academic performance. In particular, I am interested in ascertaining whether allocation to a particular residence, or group of residences, affects the academic outcomes of first year students. This paper departs from previous studies of peer interactions in higher education as allocation to residence is non-random in this setting. Students are allocated to residence primarily on choice; but where demand exceeds capacity, merit is also used as a criterion for placement. I identify a group of four 'preferred' residences where merit requirements are a prerequisite for acceptance. In following Durlauf's (1999, 2001) "membership" theory, I argue that these residences offer a premium to their members by providing a neighbourhood of other high-achieving students. The results show that there are clear benefits to both races from living in a 'preferred' residence, but the neighbourhood effect of being surrounded by high-achieving students is small and negative for white students and slightly larger and positive for Black students. Nevertheless, isolating the race effect shows that Black students suffer severe penalties in academic performance as a result of their race regardless of their residential allocation.

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I. INTRODUCTION

Ever since the publication of the Coleman Report (1966), the idea that a child's peers and surroundings are important determinants of development has spurred substantial investigation into the existence and operation of peer and neighbourhood effects. The controversial findings of this report showed that the educational achievement of Black students was positively related to the fraction of students in their school that were White. The findings of numerous other researchers also suggest that there is strong evidence to believe that peer effects exist. Case and Katz (1991), for example, find that peers influence a youth's decision to become involved in criminal behaviour and drug use; while Summers and Wolfe (1977) and Henderson et al. (1978) show that students perform better when their fellow students are high achievers. Although the strength and direction of influence varies from study to study, a rich literature on peer and neighbourhood effects including Jencks and Mayer (1990) and Rosenbaum (1992) provides a credible a priori motivation to believe that they exist and are important in determining outcomes, however measured.

The central issue I raise in this paper concerns the testing and measurement of these peer group (neighbourhood) effects in a higher education setting. In particular, I address how race and membership to different university residences affects student academic performance. This paper departs from previous studies of peer interactions in higher education (see Zimmerman (1999), Sacerdote (2001) and Winston and Zimmerman (2003)) because allocation to residence is non-random in our setting. The University of Cape Town (UCT) assigns students to housing based on a choice- and merit-based allocation policy. In general, students are assigned to the residence of their choice; but where demand for a particular residence exceeds capacity applicants with high matriculation point scores are given preference. Historically, this 'rule' has applied to four, so-called 'preferred' residences[1], namely Smuts Hall, Fuller Hall, Baxter Hall and Kopano. It is now legislated that students applying for these residences achieve above a certain threshold in their matriculation examinations to be eligible for one of these residences (University of Cape Town, 2003a). I argue that due to the nature of these residences, their status in the eyes of students and educators, and the demanding entrance criteria associated with them, these residences form an elite academic cluster. As such, I motivate that there might be benefits that accrue to being a member of such a group and by living in the neighbourhood of other high achievers. I follow Duraluf's (1999, 2001) "membership theory" of social interaction. Accordingly I define this group as an endogenous neighbourhood effect. I also investigate the case that race is important in affecting student outcomes. I define this as an exogenous race effect.

I also argue that from a methodological standpoint, my results are unbiased. There is a growing concern in the literature that previous estimates of peer influence over-estimate the magnitude of the peer- or neighbourhood-effect because they fail to control for the inherent endogeneity in the data. Although endogeneity is of real concern in this research[2], I argue that the omitted variables which cause the problem only affect residence placement insofar as they affect observed matric point scores. Therefore by including matric point scores in the regression, the results provide consistent estimates of the neighbourhood effect of living in a 'preferred' residence.

[1] This term was defined in an internal document by the Student Housing Committee (University of Cape Town, 2003a).

[2] Allocation to a 'preferred' residence is endogenous because of omitted variable bias. Wealth, family history, and school quality, for example, could all affect whether an individual is assigned to a 'preferred' residence as well as having a direct affect on outcomes.

The results of this research show that this neighbourhood effect persists even when endogeneity is controlled for. Evidence of a race-effect on academic achievement is also apparent.

The paper is organised as follows: in section II, I review the existing literature on peer-group and membership effects. Section III provides background information on the research setting as well as discussing the a priori reasons I have for believing that membership effects are important in the data. I then turn to the description of the data in section IV before outlining an empirical approach in section V. A discussion of the main results follows in section VI and concluding remarks are offered in section VII.

II. A REVIEW OF THE LITERATURE

Outside the confines of academia it is widely held that social interactions importantly affect the outcomes of individuals, however we choose to measure these outcomes. Indeed in the fields of sociology and psychology, the idea that peer- and group-level interactions are influential in shaping the behaviours of individuals is hardly disputed (Coleman (1966), Wilson (1984), and Sennett (2003)). However, the extent to which these claims can be quantified empirically is much less clear. By grounding the ideas and perceptions of sociological concepts with the rigour of economic modelling, the "new social economics" (Durlauf and Young, 2001) attempts to do just that.

There is now a substantial literature on the social interactions which give rise to peer- and neighbourhood effects. In terms of theory, it is possible to identify two main approaches. The first focuses on the role of social interactions in predetermined groups and how they act to affect group-level outcomes (Akerlof (1997), and Brock and Durlauf (1999, 2001)). Such groups might include race and gender, for example (Loury, 1977). These groups are said to be exogenously determined, as the individual has little or no control over their membership to the group. The second addresses how social interactions influence group formation (Bénabou (1993,1996), Durlauf (1996a,b), and Glaeser, Sacerdote, and Scheinkman (1996)). In these models, individuals have at least a limited say in determining their inclusion or exclusion to a group. Consequently, membership is best thought of as being endogenous. Empirical literature in this field has overwhelmingly used the residential neighbourhood as a group for analysis. In most of these papers researchers attempt to show that a child's educational performance is determined, at least in part, by the quality of school he or she attends and by the characteristics of other children and adults he interacts with in his or her neighbourhood. This hypothesis is supported by a number of important studies which provide convincing arguments that neighbourhoods and communities matter for educational outcomes (see Brooke-Gunn et al. (1993), Corcoran et al. (1992), Datcher (1982) and Haveman and Wolfe (2000) for example).

The notion that space and community interactions influence individual behaviour has been described in Durlauf (1999, 2001) as the "membership theory". At the broadest level, this theory suggests that the way in which individuals are grouped affects the socioeconomic outcomes they achieve. At the core of this theory is the belief that at least some memberships powerfully affect individual outcomes. It shows how the operation of social interactions within groups can influence individual preferences, beliefs and constraints. A complete theory of memberships should provide an explanation both for how group formation occurs and the effect of membership on individual behaviour once groups are established. Moreover, it is necessary to distinguish between exogenous and endogenous groups - an individual will clearly be affected differently by a group when membership is a matter of choice relative to when it is not (Durlauf, 2003). In particular, membership to an exogenously determined group can have long-lasting influences which persist across communities. For example, racial classification often has important impacts on the outcomes and behaviour of group members, which are similar the world over. As Glaeser and Scheinkman (2001) describe it, intragroup interactions induce intergroup heterogeneity.

In this research I examine the effects of membership to both exogenous and endogenous groups. In my example, exogenous groupings are drawn along racial lines. In particular I am interested in how being Black affects university performance. The endogenous group, on the other hand, is whether or not a student lives in a 'preferred' residence. As it is possible to be a member of both of these groups, and because each will produce a different "membership effect", I refer to the influence of the former group as a 'race effect'; and use the term 'neighbourhood effect'[3] to refer to the effects of the latter group.

There are several reasons why the operation of group interactions is important. Firstly, if it can be shown that private incentives are altered or amplified by exposure to other individuals and groups, then it is possible that a "social multiplier" exists among peer-groups and in neighbourhoods to strengthen perceptions (Durlauf, 1999). This concept could go some way to explaining some important anomalies of youth behaviour such as crime (Crane, 1991) substance abuse (Kremer and Levy, 2003) teenage pregnancy and high-school drop-out rates (Evans et al., 1992). Social interactions theories also usefully enter the debate on tracking of students by academic ability (Zimmer, 2002) and may help to explain why parents invest so heavily in choosing a school for their child, where school quality is not an issue. Finally, if we are able to understand these mechanisms to a sufficient degree, we would be able to harness the power of social peer-group influence to inform policy decisions[4].

Although I have shown that there are several statistical studies which provide evidence of group-level influences on individual performance (see summary in Table I), the reliability of this empirical evidence remains contentious. Traditionally, group-level interactions have been measured by regressing own outcomes on peer-group outcomes. This approach is problematic for several reasons. Firstly, it is rare that a researcher has a priori knowledge of which group memberships affect an individual and what the characteristics of these groups are (Durlauf and Young, 2001). If we cannot identify which groups produce causal effects, there is very little that can be said. While this research has defined the neighbourhood group to be a collection of 'preferred' residences, it is certain that this variable does not take into account all the possible combinations of peer groups that might influence an individual. These could range from the individual residence (at the broadest level) to roommates (at the narrowest level). Nonetheless, whilst I appreciate that the problem of suitable group definition is endemic to this research, I believe that the group definitions presented here are sufficiently influential and heterogeneous to be useful in this instance.

However, it is should be noted that failure to properly identify groups and interactions also increases the danger of committing omitted variable bias. Previous research shows that failure to take into account family background and schooling traits can be particularly damaging.

[3] The neighbourhood in this instance is the residence group.

[4] See Crane (1991) for an interesting discussion of his "epidemic" theory with regards to policy implications.

Evans et al. (1992) show that peer-group influence is likely to be overstated in naïve models where these variables are not taken into account. In their study the peer-group effect disappears when family background is appropriately controlled for. Behrman and Birdsall also (1983) show how failure to control adequately for school quality may cause biases in the estimated returns to schooling. Initial attempts to incorporate these effects directly were unsuccessful. I used magisterial district data on unemployment, poverty and teacher education to control for these biases, but none were significant[5].

Secondly, individuals frequently self-select into groups or neighbourhoods making it empirically difficult for the researcher to distinguish between the membership effect and the selection effect. This problem is one of the most important methodological impediments in this field of research as it usually leads to inflated estimates of group-level effects which are difficult to interpret with any degree of certainty (Manski, 1993). With very few exceptions (c.f. Evans et al. 1992) empirical studies have failed to deal seriously with the statistical biases introduced by group self-selection. Surprisingly, it turns out that by using appropriate instruments for endogenous variables, the identification of interaction effects is facilitated (Durlauf, 1999).

A third source of bias arises when individuals in a group affect each other simultaneously, because is becomes difficult to separate out the causal effect that one individual has on another from the effects that individuals experience simultaneously and independently of their peer-group. Manski (1993) calls this the reflection problem. As such, the actions of the group (independent variable) become a function of the individual's actions (dependent variable). Previous attempts to correct for this have instrumented for the independent variable using other group-level characteristics such as neighbour's parent's characteristics (Case and Katz, 1991). Nevertheless, while instrumenting for problematic causal variables can provide solutions to problems of identification, self-selection and reflection; it remains a challenge to find appropriate instruments which can be justified along a priori grounds. The use of ad hoc instruments may lull researchers into a false sense of security, even though the influence on results, where inappropriate instruments have been used, could be more pernicious than the problems they attempt to address. Several attempts were made to address the endogeneity problem in this research, with varying success. A complete discussion of these attempts can be found in section IV.

[5] Another useful method of overcoming the problems associated with group measurement in the face of unobserved individual characteristics is to use a "natural experiment" to isolate group-level effects. Examples include the Gautreaux Program and the Moving to Opportunity Demonstration as discussed in Rosenbaum (1995) and Katz, Kling and Liebman (2001) respectively.

TABLE I: SUMMARY OF EXISTING RESEARCH ON NEIGHBOURHOOD EFFECTS

Author(s)	Year	Country	Data	Membership Definition	Result
Summers and Wolfe	1977	USA	Philadelphia Schools	School	Individual student test scores are positively influenced by the achievement levels of other students in the school.
Henderson et al.	1978	USA	Montreal Schools	School	Found similar results to Summers and Wolfe (1977) in their sample.
Datcher	1982	USA	Panel Study of Income Dynamics, 1968 (PSID)	Neighbourhood defined by five-digit zip-code area	25% of difference in earnings and education differentials of blacks and whites can be attributed to neighbourhood quality.
Corcoran et al.	1987	USA	PSID	Neighbourhood defined by five-digit zip-code area	Levels of schooling decrease significantly as welfare-receipt and number of female-headed households increase in neighbourhood.
Case and Katz	1991	USA	NBER Boston Youth Survey	Three high-poverty neighbourhoods of Boston's inner-city defined by zip-code	Children who had family members in jail are more likely to end up in jail themselves; living in a neighbourhood where other youths are committing crime increases an individual's probability of committing crime even after controlling for background effects.
Crane	1991	USA	Public Use Microdata Samples (PUMS)	Neighbourhoods as defined by survey	Uses a contagion theory to show how school drop-out probabilities and teenage childbearing rates, increase significantly when the percentage of workers holding high-status jobs in the neighbourhood drops below 4%. The assumption is that social problems are contagious and are spread through peer influence.
Evans et al.	1992	USA	National Longitudinal Study of Youth (NLSY)	School[6]	The probability of a teenage girl becoming pregnant when she moves to a school in which the percentage of disadvantaged students is 25% higher, rises by 1.7 %; but these effects disappear when selection and endogeneity are controlled for.
Brooks-Gunn et al.	1993	USA	PSID, Infant Health and Development Programme (IHDP)	Family effects and neighbourhood effects, defined by five-digit zip-code area	Children growing up in affluent neighbourhoods do better than children in low-income neighbourhoods even after family effects are controlled for; home learning environments are important determinants of IQ at age 3.

[6] The peer-group effect measured in this research was the coefficient on the log of the percentage of economically disadvantaged students in a respondent's school.

III. Setting

The research in this paper addresses two important membership effects – the effect of being black (an exogenous race effect) and the effect of living in a 'preferred' residence (an endogenous neighbourhood effect). In this section I present the a priori evidence to believe that these group memberships are influential in determining student outcomes. I begin by discussing existing research on the experience of Black students in South African universities. I then take a closer look at the housing allocation policy used by UCT and the exclusive membership group, referred to here as the 'preferred' residences, which has stemmed from this policy.

Black Students' Experience at South African Universities

Very little research has been conducted into the experience of Black students' adjustment to university and that which does exist shows conflicting results (Sennett et al., 2003). Most researchers show that a significant number of Black students who do eventually make it to university perform poorly or drop out (Agar, 1990; van Heerden, 1995). Others like Sennett et al. (2003) show that there are no significant academic differences between Black and White students and that disparities between the race groups are founded primarily on social and personal-emotional adjustment. One of the major motivations for this apparent inconsistency is that it is exceedingly difficult to disentangle the various factors which contribute to the student outcome most commonly researched - academic performance. Indeed, defining academic performance is itself a challenging task.

Nonetheless, while many of the factors determining success are known to researchers, the mechanisms through which they operate are much less clear. South Africa's complicated past has led to a situation where most black Africans face severe financial difficulty, while their white counterparts are, on the whole, relatively wealthy by comparison (Stats SA, 2002). In general, race and wealth operate through different channels, but most often wealth effects serve to perpetuate and mask entrenched race effects. This presents the researcher with the particular problem of disentangling the effects of wealth, race and the combination of race and wealth on academic outcomes. This is not to say that the effects of wealth and race are the same, however they often operate through similar channels which can present a confusing story to the researcher.

Residence Allocation Policy at the University of Cape Town

Existing research on the influence of peers in higher education is still in the early stages of development. That which does exist, suggests that peer effects are evident in higher education, in both academic and social outcomes; however the way they act to affect outcomes is debatable. In this area of research, the peer effect is usually defined as the effect that an individual student has on his or her randomly-assigned roommate. In other words, the peer effect is the result of exposure to an individual (rather than a group which we argue is the case here). There is also no self-selection effect as these individuals are randomly assigned to their residences. The work of Zimmerman (1999) and Sacerdote (2001) is particularly important as both authors show that there is evidence of a peer effect in their sample. Both authors compare the GPA outcomes of students with high, average and low SAT scores with their randomly assigned roommates who themselves achieved varying SAT scores[7]. Zimmerman's strongest findings were that students in the middle of the SAT distribution were most strongly affected by their peers and that these effects were almost always more strongly linked with verbal than with mathematical SAT scores. Students with medium-SAT scores who roomed with students in the bottom 15 percent of the verbal SAT distribution tended to do significantly worse, on average, than other students. Surprisingly, students at the poles of the SAT distribution and particularly students with high-SAT scores were largely unaffected by their roommates. Winston and Zimmerman (2003) repeated this exercise across a further three colleges and produced similar results. Sacerdote pursued a similar roommate-based approach and found evidence that peer influences are important not only in GPA outcomes but also in fraternity participation. His results suggest that peer influence in academic performance is most pronounced at the poles of the SAT distribution with both strong and weaker students benefiting from rooming with a student in the top 25% of the academic index. It is interesting that the results of Zimmerman (1999) and Winston and Zimmerman (2003) differ so markedly from Sacerdote (2001). However I believe that this can be attributed to the fact that the first two papers examine the effect of rooming with a student in the bottom 15 percent of the SAT distribution while the latter defines the peer characteristic as rooming with a student in the top 25 percent of the distribution. Table II, below contains a summary of results in recent studies on peer effects.

While these papers have been highly instructive in the development of this research by shedding light on the operation of peer effects in higher education, they differ from my work in two important respects. Firstly, the peer-influence measured in this paper is a group-level effect rather than a roommate (one-to-one) effect; and secondly, allocation to student housing is non-random.

Table II: Recent Studies in Academic Peer Effects

Study	Peer Characteristic	Coefficient on Grades*	Comments
Zimmerman (1999)	Roommate's Verbal SAT in bottom 15%	-0.770 (0.027)	Impact on middle 70% of SAT distribution, Williams College
Winston and Zimmerman (2003)	Roommate's Verbal SAT in bottom 15%	-0.860 (0.034)	Impact on middle 70% of SAT distribution, three schools from College and Beyond
Sacerdote (2001)	Roommate in top 25% of Academic Rating Index	0.060 (0.028)	Dartmouth College. Controls for housing questions. Also peer effects on fraternity membership but none on major.

Admission to residence is based on a combination of a preference- and merit-based system that was developed in accordance with UCT's three-tier policy, which assumes that "a new student will initially enter a first tier (catering) residence and subsequently move to a second tier (senior catering or self-catering) residence or into third tier (semi-autonomous self-catering) accommodation" (University of Cape Town, 2003b, p.11). The Student Housing Admissions Policy, which is currently under review, allows for the admission to residence of applicants with offers of admission to a programme of full-time study who are not involved in paid daytime

[7] Grade Point Average (GPA) measures academic performance in higher education, SAT scores measure academic performance at school.

employment of 20 hours or more per week (Paragraph 4.(a)(i-v) University of Cape Town, 2003a). Most incoming first-year students are assigned to first-tier accommodation, which is comprised of fourteen residences: four for women, seven for men and three mixed-gender residences.

The university's application form allows students to list their top three residence preferences. The Student Housing Admissions Committee then uses this information together with the availability of places in the residence system to determine allocation of students into housing. However, where residence spaces are in short supply, the Committee may also use a student's unweighted matriculation points[8] to determine placement into a particular residence. This is particularly true of the 'preferred' residences, namely Smuts Hall, Fuller Hall, Kopano and Baxter Hall. Indian and White students are required to achieve 47 unweighted matriculation points to be considered for Smuts, Fuller and Baxter Hall and 44 points to be considered for Kopano[9]. Using this criterion, a student applying to Smuts Hall, for example, is required to achieve at least five "A" symbols and a "B" symbol to be considered for, though not guaranteed, a place in the residence. The cut-off for Black and Coloured students wishing to reside in these residences is 36 points, or six "C" symbols. In this way, the Committee hopes to ensure that "high achievers, within the framework of social equity, are considered for their first preference" (University of Cape Town, 2004b, p.5). Nevertheless, it should not be assumed that all students wish to be placed in 'preferred' residences. A differentiated residence fee structure, shown in Table III, might well influence residence preference through a wealth effect. The fees for the 'preferred' residences are, on average, seven percent more than that of other first tier residences and first tier fees as a whole are roughly three percent more than second tier residence fees. However, assuming that these effects are only marginal, I argue that because of the demanding entrance requirements and the high demand for 'preferred' residences there is a membership effect attached to being allocated to one of these residences.

There are several reasons why this is a reasonable assumption. Firstly, the admissions committee has itself admitted that there is a certain status associated with these residences. They are viewed by students, and indeed many educators, as being more 'academic' or 'privileged' (University of Cape Town, 2004a). This situation has occurred because the demanding entrance criteria for these residences have attracted large numbers of students enrolled in particularly challenging programmes like medicine and actuarial science. Secondly, these residences are among the oldest at UCT and are associated with a long history of excellence, honour and tradition. Moreover, two of the four (Smuts and Fuller Halls) are located on the main campus and therefore students have greater access to academic amenities and are somewhat removed from the distractions provided by other residences and the bright lights of the suburbs. Finally, the amenities in these residences are considered by many to be superior to other residences: most rooms are single rooms and the ratio of students to bathroom and kitchen facilities is lower than in other residences (University of Cape Town, 2004b). For clarity, I have grouped all other residences as 'non-preferred' residences, even though there are distinctions that could be made between them.

[8] The calculation of unweighted matriculation points as described in the application literature is known as the Admission Ratings System. The total is calculated by summing the points earned from a student's top six matriculation subjects: an A symbol (80-100%) is awarded 8 points on higher grade, 6 on standard grade; a B symbol (70-80%) is awarded 7 points on higher grade, 5 on standard grade and so on.

[9] The cut-off for Kopano was dropped to 44 points given the larger capacity of the residence.

Table III: Residence Fee Structure

Residence	Annual Fee (Rands)
A. FIRST TIER ACCOMMODATION – 'Preferred' Residences	13 350 (average fee)
Smuts Hall	13 600
Fuller Hall	13 500
Baxter Hall	13 200
Kopano	13 100
B. FIRST TIER ACCOMMODATION – 'Non-Preferred Residences	12 490 (average fee)
College House	13 100
Carinus	12 500
Clarendon	12 500
Tugwell Hall	12 400
Leo Marquad Hall	12 400
Forest Hill (G)	12 500
Glendower	12 000
Kilindini	12 500
University House	12 500
Varietas	12 500
C. SECOND TIER ACCOMMODATION	10 067 (average fee)
Groote Schuur Residence	12 300
Forest Hill Complex	10 000
Mill Court Complex	10 000
Groote Schuur Flats	8 900
Liesbeeck Gardens	9 000
The Woolsack	10 200

IV. DATA DESCRIPTION

The data used in the analysis come from UCT's database of students and include a biographical history of students as well as residence placements and academic performance at school and UCT. Biographic characteristics include race, gender, faculty, matriculation points, whether a student is in a UCT residence or lives off-campus, which residence a student is placed in, and whether a student is enrolled in the Academic Development Programme (ADP)[10]. The sample pertains to all first-year South African students enrolled at UCT in 2002. I started with a sample of 3 974 students. Of these, 379 were dropped because they were international students, 3 were dropped because they lived in 3rd Tier accommodation, and 18 were of an unclassified race. In order to identify more closely any race effects that may exist, the sample was limited to only Black and White students. This leaves a sample of 2 596 first-year, first-time UCT students. No students were repeating their first year.

Table IV: Descriptive Statistics by Race

Variable	All	Black Students	White Students
Age (years)	19.705	20.832	19.082
	(4.071)	(5.650)	(2.648)
Black	0.398	1.000	0.000
	(0.490)	(0.000)	(0.000)
Male	0.489	0.503	0.479
	(0.500)	(0.500)	(0.500)
Live in Residence	0.503	0.713	0.364
	(0.500)	(0.453)	(0.481)
Financial Aid	0.194	0.456	0.049
	(0.465)	(0.568)	(0.315)
Matriculation Points	37.156	32.881	39.602
	(7.316)	(7.556)	(5.922)
Matriculation Points Squared	1434.102	1138.214	1603.355
	(508.511)	(462.151)	(453.533)
Passes All Courses	0.505	0.396	0.577
	(0.500)	(0.489)	(0.494)

Summary statistics for all students are provided by race and residence in Tables IV and V respectively. A breakdown by race shows that just less than forty percent of students are Black with the majority of students (60.2 percent) being White. Table IV shows that of the Black students in the sample, the vast majority (71.3 percent) live in residence. This compares with only thirty-six percent of white students. However, given that the Admissions Committee limits admission for affluent students residing in the Cape Town City Council area to those obtaining forty or more unweighted matriculation points this finding is not surprising (University of Cape Town, 2003a). There are no significant gender biases across residences[11], even though there are substantial language differences across both races and residences (Table V). Only thirteen percent

[10] This programme allows students with disparities in their learning experiences to complete their degree over an extended period.

[11] On first inspection it may appear that there are considerably more men than women in the "preferred" residences, but this is only due to the larger capacity of Kopano, which provides accommodation for men only.

Table V: Descriptive Statistics by Residence and Race

Variable	Preferred Residence			Non-Preferred Residence			Non-Residence		
	All	Black	White	All	Black	White	All	Black	White
Male	0.558 (0.497)	0.526 (0.501)	0.585 (0.494)	0.471 (0.499)	0.501 (0.500)	0.425 (0.495)	0.485 (0.500)	0.497 (0.501)	0.481 (0.500)
English is Home Language	0.583 (0.494)	0.161 (0.369)	0.918 (0.275)	0.473 (0.500)	0.097 (0.296)	0.930 (0.255)	0.750 (0.433)	0.180 (0.385)	0.878 (0.328)
Age (years)	18.285 (0.784)	18.128 (0.961)	18.409 (0.582)	18.918 (2.181)	19.263 (2.719)	18.500 (1.117)	20.702 (5.297)	26.233 (8.327)	19.456 (3.220)
Matriculation Points	43.877 (4.377)	40.244 (3.760)	46.854 (1.894)	35.360 (6.735)	32.443 (6.451)	39.531 (4.604)	36.651 (7.362)	28.030 (8.426)	38.254 (5.894)
Matriculation Points Squared	1944.268 (369.061)	1633.637 (302.879)	2198.834 (169.392)	1295.675 (445.311)	1094.122 (387.186)	1583.812 (355.7570	1397.471 (500.685)	856.320 (468.500)	1498.057 (438.273)
Number of Courses Taken	8.702 (2.087)	8.720 (2.022)	8.686 (2.146)	8.383 (2.500)	8.018 (2.840)	8.931 (1.743)	8.362 (2.921)	6.752 (3.559)	8.842 (2.511)
On the ADP	0.065 (0.248)	0.143 (0.351)	0.000 (0.000)	0.207 (0.406)	0.345 (0.476)	0.000 (0.000)	0.012 (0.138)	0.073 (0.261)	0.004 (0.059)
Passes All Courses	0.702 (0.458)	0.503 (0.501)	0.870 (0.338)	0.400 (0.490)	0.317 (0.466)	0.526 (0.500)	0.533 (0.499)	0.497 (0.501)	0.544 (0.498)
On Financial Aid	0.165 (0.443)	0.321 (0.591)	0.041 (0.199)	0.365 (0.584)	0.618 (0.571)	0.056 (0.431)	0.071 (0.298)	0.171 (0.377)	0.048 (0.272)

of Black students listed English as their home language while this figure was close to ninety percent for Whites.

Financial considerations are also important for black Africans, particularly those in 'non-preferred' residences. Nearly half of all Black students are on financial aid and nearly two-thirds of Black students in 'non-preferred' residences are on financial aid.[12] Moreover, many of these students are enrolled in the ADP suggesting that they are educationally disadvantaged compares with other students. As discussed previously, this combination of race and wealth effects is problematic for researchers. It implies that in analysing the results to follow, one must bear in mind that differences in performance due to differing races will imply differing wealth structures too, in the majority of cases.

Unweighted matriculation point scores reflect academic ability and the quality of schooling that a child received as well as the resources available to them during this period. In analysing data on matriculation performance, the disparities in educational opportunity between the races are quite pronounced. Mean matriculation points of Black and White students are significantly different at the five percent level across all residence groups. There is also clear evidence of UCT's merit-based admissions policy at work. Students living in 'preferred' residences needed to achieve an average of eight points more than those in 'non-preferred' residences to guarantee a place in their desired accommodation (Table V). This finding persists across both race groups, even though the number of points required differs. However, whilst it is useful to look at point scores to get a feeling for the data, I argue that matriculation points are not of interest in this research. I suggest that they capture the effects of unobserved family background and other variables that might influence a student's residence placement. If this is the case, the coefficient on the variables 'preferred' residence and its interactions should diminish when I include the variables containing matriculation points. Thus, once matriculation points are included in the regression, residence allocation no longer reflects matriculation points since the latter has been partialed out.

The data presented so far suggests that there are strong reasons to believe that race and residence placement might affect outcomes. Necessarily, the choice of performance measure is also important. We need to find an outcome measure that will highlight the trends in the data. This process is useful and not entirely obvious.

[12] A further breakdown of this residence group shows that 74.8% of second tier residents are on financial aid compared with 58.8% of 'non-preferred' second tier residents. The high concentration of students under financial strain in these residences suggests that black Africans from disadvantaged communities are clustering in second tier residences. The reasons why this is the case are not obvious.

Measuring Student Performance: Choice of dependant variable

Unlike the matriculation point system, there is no standardised way to measure academic success at UCT. Zimmerman (1999) and Sacerdote (2001) both used the grade point average (GPA) of students as their performance measure, which is a readily available index used by most higher education institutions in the United States. Moreover, they were able to compare these GPAs across students because both research papers were conducted at liberal-arts institutions, where there was little heterogeneity in the type of programme that students were registered for. In our setting however, there is no easy way to gauge student outcomes. Data on student marks for registered courses is available, but taking a simple average of marks across courses will not provide an objective measure of outcomes for the following reasons. Firstly, it does not take into account the number of courses that a student is registered for. Clearly, a student taking only two subjects a year is likely to outperform a similar student taking twice as many subjects. Secondly, many courses at UCT are "whole-year" courses which need to be given twice the weight of a "semester-course" as they carry double the number of credits. Finally, a simple average of course marks does not take into account the heterogeneity between students in different faculties.

I investigated a number of different performance measures and model estimators in the development of this research. The first took the ratio of the number or courses passed (appropriately weighted) as a proportion of the number of courses taken. This measure was appealing as it avoided the difficulties encountered with comparing the absolute marks of students with differing course loads across faculties. However, it failed to accurately take account of the number of courses a particular student was registered for. For example, the outcome of a student who registered for two courses and only passed one would be the same as that of a student registering for ten courses and passing five. Clearly the second student should be rewarded for taking on more courses, but this is not reflected in the outcomes measure.

Secondly, I used a gap measure of performance, taking the number of courses registered for minus the number of courses passed, but once again this measure penalised students with large course loads, so it was not used. In our example, the first student would receive an outcome of one while the second would receive an outcome of five. On paper it would appear that the first student has performed better than the second, which is clearly not the case. An outcome of five would also be consistent with an individual who registered for five courses and failed all of them. Therefore it was impossible to compare outcomes between students where course loads differed.

The third approach limited the sample to only those students taking eight semester courses (or equivalent). This is generally regarded by most faculties as a "full" course load (University of Cape Town, 2004b). In this reduced sample I averaged the actual marks a student achieved across the eight courses to arrive at an outcome measure. While these results are useful in that they shed light on the operation of membership effects for the "average" student and they avoid the difficulties encountered with varying course loads, they are highly subject to a selection effect because we are, by definition, only looking at a certain type of student.

Fourthly, a tobit estimator that would be equal to the number of courses awarded if an individual passed all courses, and zero otherwise was used. In censoring the data in this way I could usefully isolate no only the probability of passing all courses but also the actual credits awarded for students who passed their full course load. This approach has promise and should be developed in further research as it captures a greater degree of the dynamic of peer interactions. However, it became increasingly difficult to structure the model in a way that would make sense given the current setting. A complete set of results for these measures is found in Table VI.

This process tended to suggest that a simpler model may yield more meaningful results, at least initially, in a situation like ours where there is heterogeneity between course loads. I decided to investigate a simple probit estimator with the binary variable "Passes All Courses Taken" as a success measure for the dependent variable, equalling one if a student achieves this goal and zero otherwise. It is appealing as we would assume that most students would aim to pass all the courses they have registered for, otherwise there would be little point registering for them in the first place. We can assume further that the university faculty office would not allow students to take on more courses than they could manage[13]. Therefore, if a student, together with the faculty office, believes that he or she can manage a given course load then he or she should logically be expected to be able to pass the full course load with much the same probability as any other student. In this way, the measure is useful as it allows us to compare students from a similar starting block.

However, since the type of courses students take and the extent to which they apply themselves will differ, I do make allowances for varying course loads by including the number of courses taken as an explanatory variable in the regression.

Thus, the final outcomes measure is "Passing all Courses Taken" which fits my profile of a flexible performance measure. I also find it to be statistically correlated at the one percent level with the other four measures discussed above. The correlation coefficients are 0.742, 0.719, 0.655 and 0.925 respectively.

Discussion of the Performance Statistics:

Turning now to how our performance measure differs between groups, the simple statistics show that students in 'preferred' residences outperform all other groups. This is especially pronounced in the case of White students where close to ninety percent pass all courses. This compares with only 52,6 percent of students in other residences and 54,4 percent for students living off campus (Table V). The difference between the housing groups, as a proportion of students, is close to one third in both instances. By contrast, Black students in 'preferred' residences are not statistically different to those living out of residence. The difference in passing all courses between Black students in 'preferred' residence and those living off-campus is only about half a percent, which is not significant at any level. This is interesting given that the latter group have, on average, twelve matriculation points less than the former. Performance averages across the races show that only 'preferred' residences will have a majority of students passing all courses; 'non-preferred' residences, the worst performers, have only 40 percent of students passing – thirty percent less than 'preferred' residences and nearly 10 percent less than students not in residence.

There is also clear evidence that a penalty is attached to being Black. Only 39,6 percent will pass all their courses. This drops to 31,7 percent for students in 'non-preferred' residences. Black students living at home or in 'preferred' residences do slightly better with 49,7 and 50,3 percent

[13] There are guidelines regarding the number of courses students are able to register for, but these are at the discretion of the faculty committee.

respectively but this is still well below the average for White students in these residence groups. The difference between White and Black performance is 36,7 percent for 'preferred' residences, 20,9 percent for 'non-preferred' residences and 4,7 percent for students living off campus. I find that 18 percent of Black students living off campus would not pass all their courses if they were to move into a 'non-preferred' residence and a similar number of White students would fail the measure if they were Black (Tables IV & V).

These statistics show that the neighbourhood effects of different residence groups are likely to be small and insignificant for Black students while White students are expected to enjoy a greater neighbourhood effect across residence group and large premiums will accrue to those in 'preferred' residences.

Table VI: Neighbourhood and Race Effects across Four Outcome Measures

Variable	Mark 1 (OLS)	Mark 2 (OLS)	Mark 3 (OLS)	Mark 4 (Tobit)
Constant	1.531 ***	-14.244 ***	1.033 ***	14.661 ***
	(0.251)	(2.802)	(0.125)	(4.289)
English is home language	0.020	-0.201	0.034 ***	0.219
	(0.019)	(0.283)	(0.009)	(0.227)
Male	-0.020	0.354	-0.007 **	0.155
	(0.018)	(0.383)	(0.003)	(0.325)
Black	-0.177	3.864	-0.373 ***	-0.594 **
	(0.254)	(3.727)	(0.085)	(0.688)
Matriculation Points	-0.044 ***	0.743 ***	-0.022 ***	-0.629 ***
	(0.002)	(0.028)	(0.003)	(0.088)
Matriculation Points Squared	0.001 ***	-0.013 ***	0.000 ***	0.012 ***
	(0.000)	(0.000)	(0.000)	(0.001)
Number of Courses Taken	-0.017 ***	0.814 ***	0.004	-0.433 ***
	(0.001)	(0.069)	(0.016)	(0.160)
Financial Aid (1=yes)	-0.024 ***	0.484 ***	0.001	-0.600 **
	(0.002)	(0.051)	(0.007)	(0.295)
Lives in a 'preferred' Residence	-0.028	0.278	0.048 ***	0.546
	(0.051)	(0.823)	(0.005)	(0.648)
Black*'preferred' Residence	0.184 ***	-2.765 ***	-0.034 ***	0.760
	(0.053)	(0.701)	(0.002)	(1.063)
Black*'preferred' Residence*Number of Courses Taken	-0.015 ***	0.230 ***		-0.186
	(0.001)	(0.069)		(0.124)
Lives in a 'non-preferred' or Second Tier Residence	-0.002	-0.006	-0.005 *	-0.373 ***
	(0.002)	(0.077)	(0.003)	(0.026)
Average Matriculation Points in Own Residence	0.000	0.020	-0.007 ***	-0.093
	(0.006)	(0.094)	(0.002)	(0.066)
Black* Average Matriculation Points in Own Residence	0.003	-0.072	0.010 ***	0.186 *
	(0.007)	(0.103)	(0.002)	(0.099)
Σ	0.253	4.551	0.121	0.124
R^2	0.178	0.268	0.176	-0.099
Likelihood	129.271	-6575.535	603.167	-4851.056
N	2367	2367	766	2367

Standard errors are reported in parenthesis; data is clustered by residence
Marginal effects $\partial y/\partial x$ are reported
*** significant at the one percent level, $p<0.01$
** significant at the five percent level, $p<0.05$
* significant at the ten percent level, $p<0.10$

V. EMPIRICAL FRAMEWORK

Choice of estimation strategy

In the first three examples of likely dependant variables discussed in the previous section, it is convention to use an ordinary least squares (OLS) approach to measure membership effects. This is the most common approach to measuring peer outcomes (see Datcher (1982), Zimmerman (1999), Sacerdote (2001), Hanushek (2001) and Winston and Zimmerman (2003) for examples) however it has received criticism from a number of sources including Durlauf (1999), who asserts that models of peer- and peer-group interactions typically produce non-linear relationships. Therefore in focussing on linear models, researchers are likely to miss some aspects of the dynamic through which group-influence operates.

The fourth and fifth options discussed are both non-linear models. The Probit, used in this analysis, is a good starting point as it offers a clear interpretation of the key factors affecting one's success. The Tobit builds on this model shedding light on how varying course loads affect performance. As this model is intended to show an overview of the trends behind the data, I focus on the simple Probit model.

Problems in estimation

Probit models are useful as they pick up some of the non-linearities that an OLS model would miss; however new biases emerge which have important implications for the analysis. Firstly, there is a strong possibility that the non-random allocation to residence introduces selection bias, which will act to prejudice the results. This is a common problem when endogenous membership effects are used to estimate peer-group influence. This bias can be overcome by choosing an appropriate instrument for the problem variable. The importance of this has been highlighted by Evans et al. (1992) who showed that after instrumenting for the peer group the neighbourhood effect disappeared. However, in extending their analysis, Rivkin (1997) showed that these results were also sensitive to the type of instruments used in the analysis. Therefore, these papers draw attention to two problems that are often overlooked in this type of analysis: firstly, that selection bias is a serious matter that needs to be controlled for; and secondly, that the choice of an appropriate instrument is equally important.

I have already mentioned that the presence of matriculation points removes the need to instrument for residence placement as the background factors which might influence placement should already be built into the matriculation point score. However, it is necessary to take time here to discuss why the endogeneity of residential placement is such a problem, what options might exist to overcome the problem, and to justify the decision to use matriculation points as a rough proxy for this variable.

The issue I face is that by claiming that outcomes are affected by living in a 'preferred' residence (the endogenous neighbourhood effect) I must also accept that there are a number of other background factors that will also influence achievement. Due to the complexity of these effects and the lack of adequate data, not all of these can be accounted for and will therefore appear in the error term. However, these background effects will also influence the probability that a student will be accepted into a 'preferred' residence. For example, one would expect that the education of a student's mother would have an effect on the student's own academic performance. However, mothers' education will also be influential in determining whether or not a student chooses and is accepted to a 'preferred' residence. In this way, the variable 'preferred' residence will be correlated with the error term, which is the classic endogeneity problem. Thus, by self-selecting into communities, students are also choosing a neighbourhood. This therefore makes the neighbourhood endogenous.

If this argument is correct, it implies that it is necessary to find an appropriate variable to instrument for residence placement[14]. In the development of this research, several attempts were made to find an appropriate instrument for residential placement, with varying success. The first took student's first preference for residence, which was highly correlated with actual placement; but without full knowledge of how student's formed their preferences it is impossible to know whether this variable would be uncorrelated with the error term. It is highly likely, for example, that a student's residential preference is influenced by a sibling or parent's own residential experience at university. Moreover, there were very few cases where students applied for a 'preferred' residence and were placed in a 'non-preferred' residence. I also investigated using the binary variable 'does not live in Cape Town' as an instrument for being in student housing. However, this variable is extremely limited in its interpretation and biases the race effect as it does not take into account the fact that specific provision is made for Black students from disadvantaged communities within Cape Town to live in residence.

As the neighbourhood effect is limited to those students living in 'preferred' residence, I also tried using the proportion of single rooms in residence to instrument for the neighbourhood effect of living in a 'preferred' residence (see Table VII for results). In section III, I discussed the motivations for grouping Smuts, Fuller, Baxter and Kopano as 'preferred' residences. One of them was that these residences typically have a much higher proportion of single rooms than other residences. I found that the proportion of single rooms is monotonically increasing as we move from non-preferred to preferred residences and can show that this variable is highly correlated with living in a preferred residence (0.85). There is also no reason why the proportion of single rooms in a given residence should be correlated with background factors like mother's education. However, proving that this variable is uncorrelated with academic performance at university is debatable.

However, it can be argued that matriculation points capture these effects making it unnecessary to find an appropriate instrument. In order to show this, it is necessary to prove that there is a strong correlation between this matriculation points and getting into a 'preferred' residence. If this is the case, the coefficient on the variables 'preferred' residence and its interactions should diminish when I include the variables containing matriculation points. Thus, once matriculation points are included in the regression, residence allocation no longer reflects matriculation points since the latter has been partialed out. Table VIII shows this to be the case both for the whole sample and the sample including only students in residence. In both instances, the coefficient on 'preferred' residence decreases with the inclusion of matriculation points.

[14] Several attempts were made to instrument for residence placement with varying success. Examples include students' first choice for residence, whether or not a student lives in Cape Town and proportion of single rooms in residence.

Table VII: Residence Allocation and Academic Outcomes by Race: IV Estimates[15]

Variable	Students in Residence	
Constant	0.647	
	(0.509)	
English is home language	0.030	
	(0.074)	
Male	0.094	***
	(0.000)	
Black	-0.204	
	(0.247)	
Matriculation Points	-0.062	***
	(0.023)	
Matriculation Points Squared	0.001	***
	(0.000)	
Financial Aid (1=yes)	-0.091	***
	(0.030)	
Number of Courses Taken	-0.103	***
	(0.008)	
Preferred Residence	0.031	◊
	(0.021)	
Black* Preferred Residence	-0.324	
	(0.229)	
Black* Preferred Residence*Number of Courses	0.006	
	(0.033)	
Average Matriculation Points in Own Residence	0.015	***
	(0.004)	
Black* Average Matriculation Points in Own Residence	0.007	
	(0.006)	
Percent Correct Predictions	0.730	
Log Likelihood	-617.971	
Chi-Squared	375.234	
n	1241	

Standard errors are reported in parenthesis; data is clustered by residence; Marginal effects $\partial y/\partial x$ are reported

*** significant at the one percent level, $p<0.01$
** significant at the five percent level, $p<0.05$
* significant at the ten percent level, $p<0.10$
◊ significant at the fifteen percent level, $p<0.15$

Another problem that is encountered has to do with the interpretation of variable coefficients. As the model stands, the coefficients on the residence variables could be capturing many effects (such as better amenities, closer access to educational facilities) as well as our variable of interest, which is the effect of being surrounded by high-achieving peers. In order to isolate this effect, it is necessary to test whether individual performance improves when average neighbourhood performance increases for White and Black students. To do this I have included two variables: the first measures the average matriculation point score in your residence; the second is identical to the first, but only for Black students. If the coefficient on the first variable is positive, then White students in residence will benefit proportionally when the average matriculation point score in their residence increases. In other words, an individual's performance will increase when the neighbourhood within which he or she lives becomes 'cleverer'. The second variable is identical but for Black students.

[15] "proportion of single rooms in residence" is used as an instrument for "preferred residence"

Defining the Estimation Model

I treat the neighbourhood effect as an exogenous variable in a single-equation probit model. Let y_1* be a binary variable measuring an individual student's propensity to pass all the courses he or she takes such that it equals one if the students passes all the courses registered for, and zero otherwise; x_1 is a vector of other characteristics including race, gender, matriculation points and whether or not a student is on financial aid. The matrix, x_1, also includes interactions of these terms. In our case, the neighbourhood variable, y_2, consists of a binary variable identifying whether a student lives in a 'preferred' residence or not. These variables are also interacted with race and other factors which might influence performance.

To illustrate this, if y_1 equals one when a student passes all courses he registers for, then this can be defined by

$$\begin{aligned} y_1 &= 1 \qquad \text{if } y_1^* \geq 0 \\ y_1 &= 0 \qquad \text{if } y_1^* < 0 \end{aligned} \tag{1}$$

Then the probability that a student will pass all the courses he registers for will be

$$\begin{aligned} \text{prob}(y_1 = 1) &= \text{prob}(\varepsilon_1 \geq -\beta_1 x_1 - \beta_2 y_2) \\ &= 1 - \Phi(-\beta_1 x_1 - \beta_2 y_2) \\ &= \Phi(\beta_1 x_1 + \beta_2 y_2), \end{aligned} \tag{2}$$

where Φ is the cumulative distribution function of the standard normal distribution.

Table VIII contains a measure of neighbourhood and race effects in student outcomes using the probit estimator for students living in university residence and for all students. The data has been clustered by residence as all students in one residence will share the same average matriculation point score for that residence and therefore fall into one cluster. The omitted groups for the two samples are students not in residence and students in 'non-preferred' residences for the whole sample and students in residence sample respectively.

Table VIII: Residence Allocation and Academic Outcomes by Race

Variable	Whole Sample				Students in Residence			
	Excluding Matric Points		Including Matric Points		Excluding Matric Points		Including Matric Points	
Constant	0.633	***	2.456	***	0.688	***	1.524	***
	(0.058)		(0.629)		(0.063)		(0.290)	
English is home language	0.056	*	0.039		0.084		0.043	
	(0.029)		(0.028)		(0.053)		(0.073)	
Male	-0.031	**	0.008		-0.015	**	0.057	***
	(0.012)		(0.034)		(0.006)		(0.011)	
Black	-0.122	***	-0.710	***	-0.165	***	-0.290	**
	(0.026)		(0.215)		(0.037)		(0.148)	
Matriculation Points			-0.104	***			-0.078	***
			(0.019)				(0.014)	
Matriculation Points Squared			0.002	***			0.002	***
			(0.000)				(0.000)	
Financial Aid (1=yes)	-0.117	***	-0.062	**	-0.129	***	-0.091	***
	(0.016)		(0.029)		(0.018)		(0.026)	
Number of Courses Taken	-0.068	***	-0.096	***	-0.086	***	-0.094	***
	(0.009)		(0.001)		(0.008)		(0.001)	
Lives in a 'preferred' Residence	0.390	***	0.170	***	0.446	***	0.146	***
	(0.001)		(0.051)		(0.001)		(0.031)	
Black*'preferred' Residence	-0.018		-0.041		-0.086	***	0.070	***
	(0.031)		(0.074)		(0.008)		(0.005)	
Black*'preferred' Residence*Number of Courses Taken	-0.033	***	-0.022	***	-0.019	***	-0.024	***
	(0.009)		(0.001)		(0.001)		(0.001)	
Lives in a 'non-preferred' or Second Tier Residence	-0.053	***	-0.049	***				
	(0.016)		(0.004)					
Average Matriculation Points in Own Residence			-0.011	*			-0.002	***
			(0.007)				(0.000)	
Black* Average Matriculation Points in Own Residence			0.022	**			0.007	**
			(0.011)				(0.003)	
Percent Correct Predictions	0.667		0.711		0.694		0.707	
Log Likelihood	-1585.090				-750.000		-1306.322	
Chi-Squared	432.1451		663.125		345.141		660.070	
N	2367				1241			

Standard errors are reported in parenthesis; data is clustered by residence
Marginal effects $\partial y/\partial x$ are reported

- *** significant at the one percent level, $p<0.01$
- ** significant at the five percent level, $p<0.05$
- * significant at the ten percent level, $p<0.10$

Table IX: Summary of Partial Derivatives

Partial	Whole Sample	Students In Residence
$\frac{\partial E(y\mid x)}{\partial Black}$	- 0.710	-0.290
$\frac{\partial E(y\mid x)}{\partial Black\ \partial Preferred}$	0.060	-0.006
$\frac{\partial E(y\mid x)}{\partial Preferred}$	0.170	0.146

y refers to the probability of passing all courses. The partial effects are all significant at least at the 15% level and are based on the marginal effects presented in Table IV and V. The estimates on which these partials are based also take account of clustering at the residence level.

VI. DISCUSSION OF RESULTS

Exogenous Membership: The Race Effect on Academic Outcomes

The results presented in Table VIII reveal an interesting story about the way in which membership effects operate within and between races. The effect of being Black, regardless of residence placement, has a significantly negative impact on outcomes. Black students suffer a severe penalty on the probability that they will pass all the courses they register for compared with white students even if the student lives in residence. However Black students living in residence have a far greater chance of passing all the courses they take than fellow Black students living off campus. In fact, by living in residence a representative student can increase his or her chances of passing all courses by more than forty percent.

Black students appear to be relatively unaffected by living in preferred residences when compared with students who are not in residence, but perform significantly better when compared with students in 'non-preferred' residences. Black students also incur a penalty of about two percent per extra course they register for. The most plausible explanation for this is that many Black students at UCT are part of the Academic Development Programme (ADP). Many of these students take a lighter course load compared with non-ADP students and would find it much harder to pass all their courses if they were to register for a full course load.

Endogenous Membership: The Neighbourhood Effect on Outcomes by Living in a 'preferred' Residence

The empirical estimates in the probit model reinforce our suspicion that peer group influences are operating in residence. The size and sign of the coefficients on the residence variables as well as their significance justifies this. The results suggest that both Black and White students are at an advantage when being awarded a place in a 'preferred' residence. White students enjoy a premium of between fourteen and seventeen percent relative to all other students; and Black students enjoy a premium of about seven percent when compared with other students in residence. Wald tests show that the premium available to White students in 'preferred' residences is significantly larger at least at the ten percent level than that available to Black students in 'preferred' residences for both samples. White students in these residences also enjoy a large and significant premium over students in 'non-preferred' residences, while there is an insignificant difference between Black students in 'preferred' residences and other Black students in residence[16].

The results show that academic outcomes are negatively related to an increase in average matriculation point scores in residence for White students, but are positive for Black students. They imply that a five point increase in average matriculation point scores in residence decreases the probability of passing all courses for White students by one percent, and raises the probability for Black students to three and a half percent. This result would seem to contrast earlier evidence

[16] The Wald statistics are 0.546 (0.324) and 0.196 (0.093) for the null hypothesis that White students in 'preferred' residences enjoy a higher premium than Black students in 'preferred' residences for the full and restricted sample respectively. In testing the null hypothesis that White students in 'preferred' residences enjoy a larger premium than those not in residence the Wald statistics are 0.567 (0.131); and in testing the difference between Black students in 'preferred' and 'non-preferred' residences, the coefficient is insignificant and equal to 0.021 (0.195).

showing that the coefficient of being Black and in a 'preferred' residence negatively impacts on performance. However, as this measure relies on individual residences as opposed to residence groups it is highly plausible that this mechanism is operating at the margin and that Black students, in particular, benefit from being in an environment where intellectual capital is abundant. This result is also important as it suggests that non-linearities could exist between individual residences to influence outcomes. Although these effects are small, their trend is consistent and significant in both samples.

Partial Effects:

Table IX provides a summary of the marginal effects on outcomes by race and residence group. On the whole, they tend to show that Black students incur a penalty on outcomes regardless of whether they live in or out of residence. A black student is 71 percent less likely to pass all courses relative to a White student; and Black students living in 'non-preferred' residences are nearly 30 percent less likely to pass all their courses than a fellow White student.

The results also show that, in general, there are benefits that accrue to those placed in 'preferred' residences. A White student moving to a 'preferred' residence from her home off-campus would increase the probability of passing all courses by 17 percent. If the same student moved from a 'non-preferred' residence to a 'preferred' one, the increase in probability would be 14,6 percent. The interaction of these shows that the probability of a Black student living in a 'preferred' residence passing all his/her courses is 6% higher than it would otherwise be.

There is a distinct pattern that emerges from these marginal effects. Students in 'preferred' accommodation enjoy a premium in academic housing (17%; 14%); Black students in these residences also enjoy a premium, but this is smaller than white students (11%; 14%); and all Black students are penalised for their race (71%; 29%). The numbers in the brackets are the marginal effects for the whole sample and the residence sample respectively. It is noticeable that the effects of race and residence are more pronounced when one is looking at the whole sample rather than students in residence even though this need not be the case.

The interaction of the marginal effects shows that the probability of a Black Student living in a 'preferred' residence passing all his or her courses is 15 percent less than a White student living in a 'non-preferred' residence. This student incurs a 29 percent penalty for being Black, a 0.6 percent penalty for being Black and living in a 'preferred' residence and a premium of 14,6 percent for living in a 'preferred' residence. When compared with a White student not living in residence the penalty is closer to 48 percent.

VII. CONCLUSION

In the social interactions literature to date, theory has run considerably ahead of empirical testing. Although there is a strong prima facie case that these interactions exist to influence academic and social outcomes, the importance and magnitude of their influence remains largely unknown. This is not to say that and operation of peer influence, but the literature has so far failed to adequately control for the inherent problems associated with endogeneity. Few studies (c.f. Evans et al. 1992) have confronted this issue as a serious problem. The problem of defining the 'peer-group' appropriately is equally important and worthy of attention.

This research draws on Durlauf's (1999, 2001) membership theory of social interactions by analysing the effects of neighbourhood and race in university residences at UCT. I have argued that a group of four so-called 'preferred' residences offer exclusive membership effects to their residents by providing them with superior amenities, a neighbourhood of high-calibre students and a tradition of academic excellence. As allocation to these residences is largely contingent on student choice, there is a strong selection effect in this sample. However, I have shown that this effect is removed when observed matriculation point scores enter the regression equation directly.

The results reported here are by no means definitive, but they do provide preliminary evidence that the effects of race and neighbourhood are important determining academic performance. The results show that Black students experience a large and significant penalty for being Black, but perform relatively better compared with other students in residence when living in a 'preferred' residence. White students on the other hand, enjoy a large and significant premium by living in a 'preferred' residence relative both to students in other residences and students living off campus. I also show that there are significant differences between races, between residence groups and between races within residence groups. Finally, the results show that peer group influence within residence is small but significant. Contrary to previous research such as Summers and Wolfe (1977) and Henderson et al. (1978), I found that White students tend to perform worse when the average matriculation point score in their residence increased. Thus while these students enjoy a large premium by being in a 'preferred' residence, the improvement in their academic performance cannot be attributed to the fact that they are surrounded by high-achievers. On the other hand, Black students are positively affected when the average matriculation point scores of their residence go up, and this is effect is larger than that for White students.

Thus, even though the peer-group effects identified in this research are small and examine only a thin segment of student behaviours and outcomes, there is hope that if peer-group influence can be found in such a narrow band of student characteristics and outcomes, it is likely to exist in other samples with other outcomes and with greater magnitude.

VIII. References

Agar, D. (1990): "Non-Traditional Students: Perceptions of Problems which Influence Academic Success." Higher Education, 19, 435-54

Akerlof, G.A. (1997): "Social Distance and Social Decisions." *Econometrica* 65, 1005-27

Anderson, K.G., D. Lam, and H. Kaplan (2000): "Grade Repetition, Schooling Attainment, and Family Background in South Africa." University of Ann Arbor, Michigan.

Behrman, J. and N. Birdsall (1983): "The Quality of Schooling: Quantity Alone is Misleading." *American Economic Review*, 73(5), 928-46

Bénabou, R. (1993): "Workings of a City: Location, Education, and Production." *Quarterly Journal of Economics* 108, 619-652

Bénabou, R. (1996): "Equity and Efficiency in Human Capital Investment: The Local Connection," *Review of Economic Studies,* 62, 237-264

Berndt E.R. (1991): "Causality and Simultaneity between Advertising and Sales" *The Practice of Econometrics: Classic and Contemporary,* Addison-Wesley

Brock, W. and S. Durlauf (1999): "A Formal Model of Theory Choice in Science." *Economic Theory,* 14, 113-130

Brock, W. and S. Durlauf (2001): "Discrete Choice with Social Interactions" *Review of Economic Studies,* 68, 235-60

Brock, W. and S. Durlauf (2003): "Multinomial Choice with Social Interactions" University of Wisconsin Working Paper.

Brooks-Gunn, J., G.J. Duncan, P.K. Klebanov, and N. Sealand (1993): "Do Neighbourhoods Influence Child and Adolescent Development?" *American Journal of Sociology,* 99(2), 353-95

Case, A. and L. Katz (1991): "The Company you Keep: The Effects of Family and Neighbourhood on Disadvantaged Youths." *National Bureau of Economic Research*, Working Paper No. 3705

Coleman, J. (1966): "Equality of Educational Opportunity." Washington DC: U.S. Government Printing Office

Coleman, J.S. (1988): "Social Capital in the Creation of Human Capital." *American Journal of Sociology, Supplement,* 94, S95-120

CORCORAN, M., R. GORDON, D. LAREN, AND G. SOLON (1987): "Intergenerational Transmission of Education, Income and Earnings." Unpublished Manuscript. University of Michigan, Ann Arbor.

CORCORAN, M., R. GORDON, D. LAREN, AND G. SOLON (1992): "The Association between Men's Economic Status and Their Family and Community Origins." *Journal of Human Resources,* 27(4), 575-601

CRANE, J. (1991): "The Epidemic Theory of Ghettos and Neighbourhood Effects on Dropping out and Teenage Childbearing." *American Journal of Sociology*, 96(5), 1226-59

DATCHER, L. (1982): "Effects of Community and Family Background on Achievement." *Review of Economics and Statistics*, 64, 32-41

DURLAUF, S. (1996a): "A Theory of Persistent Income Inequality," *Journal of Economic Growth,* 1, 75-93

DURLAUF, S. (1996b): "Neighbourhood Feedbacks, Endogenous Stratification, and Income Inequality," in *Dynamic Disequilibrium Modelling,* W. Barnett, G. Gandolfo, and C. Hillinger eds., Cambridge: Cambridge University Press.

DURLAUF, S. (1999): "The Memberships Theory of Inequality: Ideas and Implications." in *Elites, Minorities and Economic Growth,* E. Brezis and P. Temin, eds., Amsterdam: North Holland.

DURLAUF, S. (2001): "The Memberships Theory of Poverty: The Role of Group Affiliations in Determining Socioeconomic Outcomes," in *Understanding Poverty in America,* S. Danziger and R. Haveman eds., Cambridge:Cambridge:Harvard University.

DURLAUF, S. (2003): "Groups, Social Influences and Inequality: A Memberships Theory Perspective on Poverty Traps" University of Wisconsin Working Paper.

DURLAUF, S. AND H.P. YOUNG (2001): "The New Social Economics" in *Social Dynamics: Economic Learning and Social Evolution,* S. Durlauf and H.P.Young eds., MA: MIT Press.

EVANS, W., W. OATES, AND R. SCHWAB (1992): "Measuring Peer Group Effects: A Study of Teenage Behaviour." *Journal of Political Economy*, 100(5), 966-91

GLAESER, E., B. SACERDOTE, AND J. SCHEINKMAN (1996): "Crime and Social Interactions." *Quarterly Journal of Economics,* 111:507-548

GLAESER, E. AND J. SCHEINKMAN (2001): "Measuring Social Interactions" in *Social Dynamics: Economic Learning and Social Evolution,* S. Durlauf and H.P.Young eds., MA: MIT Press.

GREENE, W.H. (1998): "LIMDEP Version 7 User's Manual." Castle Hill: NSW (Australia), Econometric Software

HANUSHEK, E. (1986): "The Economics of Schooling: Production and Efficiency in Public Schools." *Journal of Economic Literature*, 24(3), 1141-77

HANUSHEK, E., J.F. KAIN, J.M. MARKMAN, AND S.G. RIVKIN (2001): "Does Peer Ability Affect Student Achievement?" *National Bureau of Economic Research,* Working Paper No. 8502

HAVEMAN, R., AND B. WOLFE (1995): "The Determinants of Children's Attainments: A Review of Methods and Findings." *Journal of Economic Literature,* XXXIII(Dec), 1829-78.

HENDERSON, V., P. MIESZKOWSKI, AND Y. SAUVAGEAU (1978): "Peer Group Effects and Educational Production Functions." *Journal of Public Economics* 10 (Aug), 97-106

JENCKS, C., AND S.E. MEYER (1990): "The Social Consequences of Growing up in a Poor Neighbourhood," a. M.G.H.M. Laurence E. Lynn Jr., *Inner City Poverty in the United States.* Washington, DC: National Academy

JOHNSTON, J. AND J. DINARDO (1997): "Econometric Methods", McGraw-Hill

KATZ, L., J. KLING, AND J. LIEBMAN (1997): "Moving to Opportunity in Boston: Early Impacts of a Housing Mobility Programme." *Mimeo. Harvard University.*

KREMER, M. AND D.M. LEVY (2003): "Peer Effects and Alcohol Use among College Students." *National Bureau of Economic Research,* Working Paper No. 9876

LOURY, G. (1977): "A Dynamic Theory of Racial Income Differences" in *Women, Minorities, and Employment Discrimination,* P. Wallace and A. Lamond, eds., Lexington: Lexington Books.

MANSKI, C.F. (1993): "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies,* 60(3), 531-42

MOFFITT, R.A. (2001): "Policy Interventions, Low-level Equilibria, and Social Interactions" in *Social Dynamics: Economic Learning and Social Evolution,* S. Durlauf and H.P.Young eds., MA: MIT Press.

ROSENBAUM, J. (1992): "Black Pioneers – Do Their Moves to the Suburbs Increase Economic Opportunity for Mothers and Children?" *Housing Policy Debate* 2, 1179-1213

ROSENBAUM, J. (1995): "Changing the Geography of Opportunity by Expanding Residential Choice: Lessons from the Gautreaux Program." *Housing Policy Debate* 6, 231-269

SACERDOTE, B. (2001): "Peer Effects with Random Assignment: Results for Dartmouth Roommates." *Quarterly Journal of Economics,* May, 681-704

SENNETT, J., G. FINCHILESCU, K. GIBSON, AND R. STRAUSS (2003): "Adjustment of Black Students at a Historically White South African University." *Educational Psychology,* 23(1), 107-116

STATISTICS SA (2002): Labour Force Survey

SUMMERS, A.A. AND B. WOLFE (1977): "Do Schools Make a Difference?" *American Economic Review,* LXVII(67), 639-52

UNIVERSITY OF CAPE TOWN (2003 a): "Policy on Admission to Student Housing." *University of Cape Town*

UNIVERSITY OF CAPE TOWN (2003 b): "Undergraduate Prospectus." *University of Cape Town*

UNIVERSITY OF CAPE TOWN (2004a): "Directions for Applicants." *University of Cape Town*

UNIVERSITY OF CAPE TOWN (2004b): "Student Accommodation – General Application Information." *University of Cape Town*

UNIVERSITY OF CAPE TOWN (2004c): Faculty Handbooks, *University of Cape Town.*

VAN HEERDEN, E. (1995): "Black University Students in South Africa: The Influence of Sociocultural Factors on Study and Performance", *Anthropology and Education Quarterly,* 26, 50-80.

WILSON, B. (1984): "Problems of University Adjustment Experienced by Undergraduates in a Developing Country", *Higher Education,* 13, 1-22.

WINSTON, G.C. AND D ZIMMERMAN (2003): "Peer Effects in Higher Education." *National Bureau of Economic Research,* Working Paper No. 9501

ZIMMER, R. (2003): "A New Twist in the Educational Tracking Debate." *Economics of Education Review,* 22(3), 307-15

ZIMMERMAN, D.J. (1999): "Peer Effects in Academic Outcomes: Evidence from a Natural Experiment." Williams Project on the Economics of Higher Education Discussion Paper No.52